data incubator application challenge

April 14, 2020

```
In [336]: import numpy as np
          import random
          import pandas as pd
          from scipy import stats
          import matplotlib.pyplot as plt
          import seaborn as sns
          %matplotlib inline
          from sklearn.preprocessing import Normalizer
          from sklearn.feature_extraction.text import ENGLISH_STOP_WORDS
```

```
In [332]: import warnings
          warnings.filterwarnings("ignore")
```

0.0.1 Challenge 1

```
In [1]: from sklearn.feature_extraction.text import CountVectorizer
        from sklearn.model_selection import train_test_split
        from sklearn.linear_model import LogisticRegression
        from sklearn.linear_model import LogisticRegressionCV
        from sklearn.model_selection import GridSearchCV
        import mglearn
        from sklearn.metrics import roc_auc_score
        from sklearn.model_selection import cross_val_score
        from sklearn.model_selection import cross_validate
        from sklearn.pipeline import make_pipeline
        from sklearn.svm import LinearSVC
        from scipy.sparse import hstack
        from sklearn.feature_extraction.text import TfidfVectorizer, TfidfTransformer
        from sklearn.preprocessing import Normalizer
        import sys
        from sklearn import preprocessing
        from sklearn import tree
        from sklearn.ensemble import RandomForestClassifier
        from sklearn.model_selection import cross_val_score
```

```
/Users/admin/anaconda/lib/python3.6/site-packages/sklearn/externals/six.py:31: DeprecationWarni
  "(https://pypi.org/project/six/).", DeprecationWarning)
/Users/admin/anaconda/lib/python3.6/site-packages/sklearn/externals/joblib/__init__.py:15: Depr
```

```
  warnings.warn(msg, category=DeprecationWarning)


In [613]: demo.shape

Out[613]: (10844, 6)

In [4]: hm=pd.read_csv("/Users/admin/desktop/data incubator 2020/happydb/cleaned_hm.csv")
        demo=pd.read_csv("/Users/admin/desktop/data incubator 2020/happydb/demographic.csv")

In [46]: demo.index=demo.wid

In [47]: hm.shape,demo.shape

Out[47]: ((100535, 14), (10844, 6))

In [48]: hm.ground_truth_category.value_counts()

Out[48]: affection           4810
         achievement         4276
         bonding             1750
         enjoy_the_moment    1514
         leisure             1306
         nature               252
         exercise             217
         Name: ground_truth_category, dtype: int64

In [8]: hm.predicted_category.value_counts()

Out[8]: affection           34168
        achievement         33993
        enjoy_the_moment    11144
        bonding             10727
        leisure              7458
        nature               1843
        exercise             1202
        Name: predicted_category, dtype: int64

In [9]: hm['age']=hm.wid.replace(demo.age)
        hm['country']=hm.wid.replace(demo.country)
        hm['gender']=hm.wid.replace(demo.gender)
        hm['marital']=hm.wid.replace(demo.marital)
        hm['parenthood']=hm.wid.replace(demo.parenthood)

In [10]: hm.gender.value_counts()

Out[10]: m    57690
         f    42069
         o      697
         Name: gender, dtype: int64
```

```
In [60]: #use marital to clean the age catogories - if anyone is aged less than 14 (for exampl
         #and is belongs to any of the unreasonal marital status will be discarded
         hm.groupby('marital').count().wid/hm.shape[0]
```

```
Out[60]: marital
         divorced     0.037828
         married      0.411230
         separated    0.006455
         single       0.538181
         widowed      0.004745
         Name: wid, dtype: float64
```

```
In [62]: #use parenthood to clean the age catogories - if anyone is aged less than 10 (for exa
         #and is belongs to any of the unreasonal marital status will be discarded
         hm.groupby('parenthood').count().wid/hm.shape[0]
```

```
Out[62]: parenthood
         n    0.606127
         y    0.393097
         Name: wid, dtype: float64
```

```
In [59]: #whether country can be separated into two groups - developing and developed
         hm['country'].value_counts().shape
```

```
Out[59]: (100,)
```

```
In [63]: #age need to be cleaned, I trust respond from age 4~5 to 100
         hm['age'].value_counts().sort_index().head()
```

```
Out[63]: 17.0      6
         18      245
         18.0    219
         19      564
         19.0    440
         Name: age, dtype: int64
```

0.0.2 Data cleaning

```
In [66]: hm.dtypes
```

```
Out[66]: hmid                    int64
         wid                     int64
         reflection_period      object
         original_hm            object
         cleaned_hm             object
         modified                 bool
         num_sentence            int64
         ground_truth_category  object
         predicted_category     object
```

```
age                     object
country                 object
gender                  object
marital                 object
parenthood              object
dtype: object
```

```
In [74]: hm.shape
```

```
Out[74]: (100535, 14)
```

```
In [91]: age_txt=[]
         for i in range(len(hm)):
             try:
                 float(hm.age.iloc[i])
             except ValueError:
                 age_txt.append(hm.age.iloc[i])
```

```
In [93]: np.unique(age_txt)
```

```
Out[93]: array(['60yrs', 'prefer not to say', 'á'], dtype='<U17')
```

```
In [187]: hm_age_c.shape
```

```
Out[187]: (100490, 14)
```

```
In [294]: hm_age_c=hm[hm.age!='prefer not to say']
          hm_age_c=hm_age_c[hm_age_c.age!='á']
          hm_age_c=hm_age_c.replace('60yrs',60.0)
```

```
In [295]: hm_age_c.age=pd.to_numeric(hm_age_c.age)
```

```
In [296]: ## or age with parenthood stus to clean anormalies
          age14_p_idx=hm_age_c.index[np.where((hm_age_c.age<14)& (hm_age_c.parenthood=='y'))[0]
```

```
In [297]: # use info from age and marital status
          age14_d_idx=hm_age_c.index[np.where((hm_age_c.age<14)& (hm_age_c.marital=='divorced')
          age14_m_idx=hm_age_c.index[np.where((hm_age_c.age<14)& (hm_age_c.marital=='married'))
          age14_w_idx=hm_age_c.index[np.where((hm_age_c.age<14)& (hm_age_c.marital=='widowed'))
          age14_s_idx=hm_age_c.index[np.where((hm_age_c.age<14)& (hm_age_c.marital=='separated
```

```
In [298]: for txt in ['p','d','m','w','s']:
              try:
                  hm_age_c=hm_age_c.drop(globals()['age14_'+txt+'_idx'])
              except KeyError:
                  continue
```

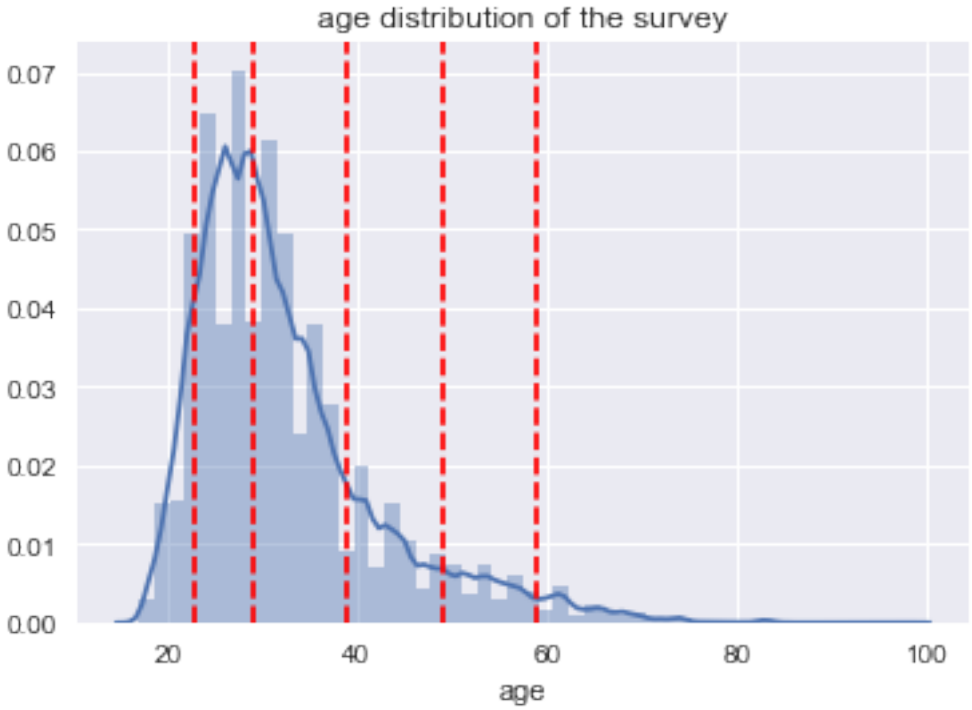
```
In [299]: age5_idx=hm_age_c.index[np.where(hm_age_c.age<5)]
```

```
In [300]: hm_age_c.loc[age5_idx].wid.value_counts()
          #after examing the sentence they wrote, it 's clear that they are adults or at least
          #for simplication and lack of information for correction I simply discard the four p
```

```
Out[300]: 62       75
          3554      6
          12450     3
          12446     3
          Name: wid, dtype: int64

In [301]: hm_age_c=hm_age_c.drop(age5_idx)

In [302]: age15_idx=hm_age_c.index[np.where(hm_age_c.age<15)]

In [303]: hm_age_c.age.value_counts().sort_index().head()

Out[303]: 17.0       6
          18.0     464
          19.0    1004
          20.0    1517
          21.0    2536
          Name: age, dtype: int64

In [304]: hm_age_c.age.value_counts().sort_index().tail()

Out[304]: 88.0      6
          95.0      3
          98.0      3
          227.0     9
          233.0    51
          Name: age, dtype: int64

In [305]: #all from the same person and she has a grandmother, obviously a typo for her age, n
          hm_age_c=hm_age_c.drop(hm_age_c.index[np.where(hm_age_c.age==227)[0]])

In [306]: hm_age_c[hm_age_c.age==233].original_hm.iloc[2]
          #obviously another typo for age,and all from the same person

Out[306]: 'My mom and sister and I were laughing about memories together. Was a change from hou

In [307]: hm_age_c=hm_age_c.drop(hm_age_c.index[np.where(hm_age_c.age==233)[0]])

In [227]: # hm_age_c[(hm_age_c.age>80)&(hm_age_c.marital=='single')].wid.value_counts()

In [230]: #after cleaning the dataset based on age
          # hm_age_c.groupby('wid').count()

In [308]: #drop Nan in age
          hm_age_c=hm_age_c.dropna(subset=['age'])

In [394]: hm_age_c=hm_age_c.drop(hm_age_c.index[hm_age_c.gender=='o'])

In [396]: # hm_age_c
```

In [612]:
```
sns.distplot(hm_age_c.age)
plt.title('age distribution of the survey')
plt.axvline(x=23,c='red',ls='--')
plt.axvline(x=29,c='red',ls='--')
plt.axvline(x=39,c='red',ls='--')
plt.axvline(x=49,c='red',ls='--')
plt.axvline(x=59,c='red',ls='--')
```

Out[612]:
```
<matplotlib.lines.Line2D at 0x1aca85be0>
```

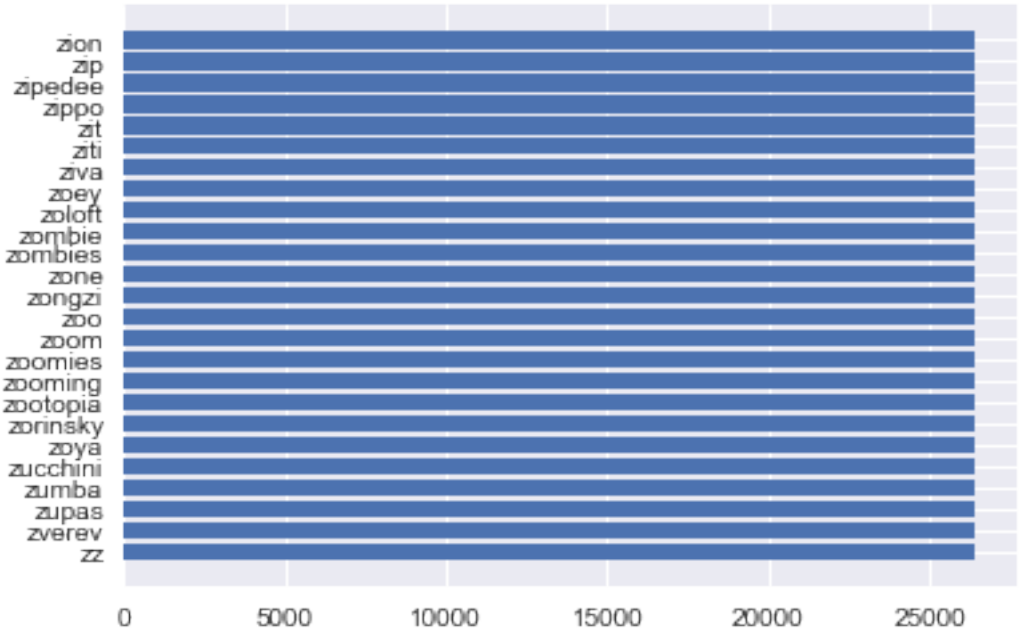


In [310]:
```
hm_age_c['age17-23']=hm_age_c.age.apply(lambda x: (x<=24) )
hm_age_c['age24-29']=hm_age_c.age.apply(lambda x: ((x<29) and (x>24)))
hm_age_c['age30-39']=hm_age_c.age.apply(lambda x: ((x<40) and (x>=30)))
hm_age_c['age40-49']=hm_age_c.age.apply(lambda x: ((x<50) and (x>=40)))
hm_age_c['age50-59']=hm_age_c.age.apply(lambda x: ((x<60) and (x>=50)))
hm_age_c['age_60plus']=hm_age_c.age.apply(lambda x: (x>=60))
```

In [526]:
```
from sklearn.feature_extraction.text import CountVectorizer
vect = CountVectorizer()
alltxt=hm_age_c.original_hm.values
vect.fit_transform(alltxt)
```

Out[526]:
```
<99541x26416 sparse matrix of type '<class 'numpy.int64'>'
        with 1451152 stored elements in Compressed Sparse Row format>
```

```
In [527]: word_freq=vect.vocabulary_

In [528]: wf_df=pd.DataFrame(word_freq.items(),index=word_freq.keys())

In [530]: wf_df=wf_df.iloc[:,1]

In [534]: wf_df_sort=wf_df.sort_values(ascending=False)

In [607]: fig, ax = plt.subplots()
          ax.barh(np.arange(25), wf_df_sort.iloc[:25], align='center')
          ax.set_yticks(np.arange(25))
          ax.set_yticklabels(wf_df_sort.index[:25])
          plt.show('words with top frequency')
          plt.show()
```




```
In [550]: young_data=hm_age_c[hm_age_c['age17-23']==True]
          alltxt_young=young_data.original_hm.values
          vect.fit_transform(alltxt_young)

Out[550]: <17932x11200 sparse matrix of type '<class 'numpy.int64'>'
                  with 251832 stored elements in Compressed Sparse Row format>

In [551]: word_freq_young=vect.vocabulary_
          word_freq_young=pd.DataFrame(word_freq_young.items(),index=word_freq_young.keys())
          # word_freq_young_sort={k: v for k, v in sorted(word_freq_young.items(), key=lambda

In [552]: word_freq_young=word_freq_young.iloc[:,1]

In [556]: word_freq_young_sort=word_freq_young.sort_values(ascending=False)

In [559]: # word_freq_young_sort.tail(100)
```

0.0.3 Models trials

binomial age prediction

age 17-23 collge age (youngest group)

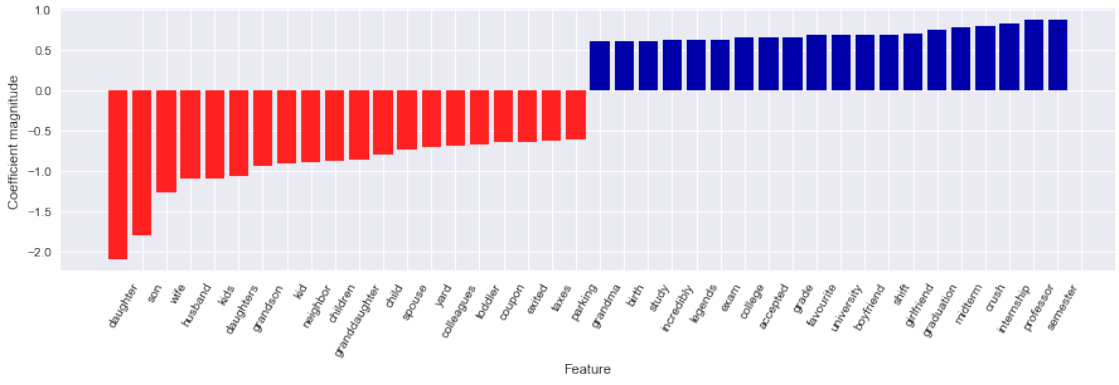
```
In [560]: vect = CountVectorizer(min_df=20)
```

```
In [609]: target=hm_age_c['age17-23']
          txtpred=hm_age_c.original_hm
          X_train,X_test, y_train, y_test=train_test_split(txtpred,target)
```

```
In [610]: X_train_review = vect.fit_transform(X_train)
          X_test_review = vect.transform(X_test)
          feature_names = vect.get_feature_names()
```

```
In [611]: #train on vectorizing-title-review-then-concatenate logistic regression with tuning
          param_grid = {"C": np.logspace(-2, -1, 6)}
          gridlr_title = GridSearchCV(LogisticRegression(class_weight='balanced',solver='lbfgs
          gridlr_title.fit(X_train_review, y_train)
          print('ROC AUC for title lr with tuning (training set):',gridlr_title.score(X_train_r
          print('ROC AUC for title lr with tuning (testing set):',gridlr_title.score(X_test_rev
          print('best C for title lr model:',gridlr_title.best_params_)
          mglearn.tools.visualize_coefficients(gridlr_title.best_estimator_.coef_, feature_name
          plt.show()
          plt.figure(dpi=300)
```

```
ROC AUC for title lr with tuning (training set): 0.7476198629399203
ROC AUC for title lr with tuning (testing set): 0.6978338561995238
best C for title lr model: {'C': 0.06309573444801933}
```

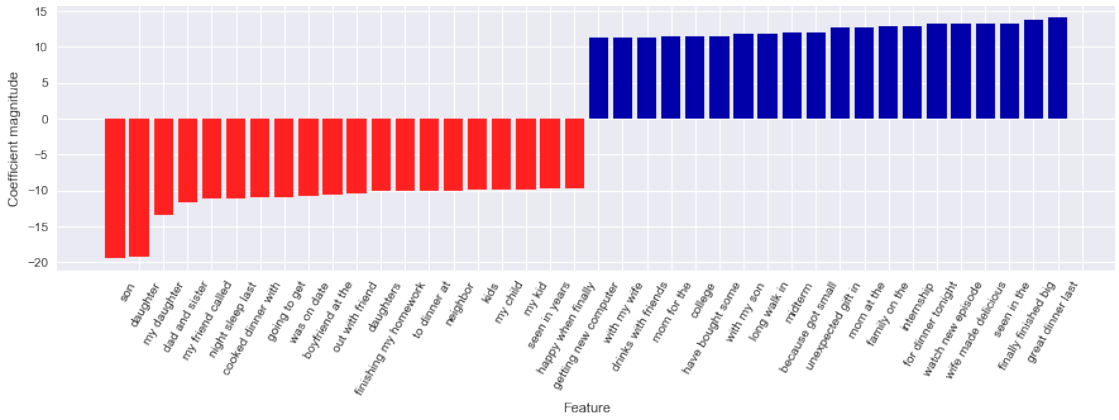



```
Out[611]: <Figure size 1800x1200 with 0 Axes>
```

```
<Figure size 1800x1200 with 0 Axes>
```

```
In [344]: #train on vectorizing-title-review-then-concatenate logistic regression with tuning
          param_grid = {"tfidfvectorizer__min_df": [1,2,3],
                        "tfidfvectorizer__stop_words":[None, 'english']}
          grid_tfid_young = GridSearchCV(make_pipeline(TfidfVectorizer(ngram_range=(1,3)),
                                       LogisticRegressionCV(class_weight='balanced',solver='sag
                                       memory="cache_folder"),param_grid=param_grid,cv=5,scorin
          grid_tfid_young.fit(X_train, y_train)
          print('ROC AUC fo2r title lr with tuning (training set):',grid_tfid_young.score(X_tra
          print('ROC AUC for title lr with tuning (testing set):',grid_tfid_young.score(X_test
          print('best C for title lr model:',grid_tfid_young.best_params_)
          feature_names=grid_tfid_young.best_estimator_.named_steps['tfidfvectorizer'].get_feat
          mglearn.tools.visualize_coefficients(grid_tfid_young.best_estimator_.named_steps['log
```

```
ROC AUC fo2r title lr with tuning (training set): 0.9995237046560832
ROC AUC for title lr with tuning (testing set): 0.6969866923144045
best C for title lr model: {'tfidfvectorizer__min_df': 1, 'tfidfvectorizer__stop_words': None}
```



Young group2 age from 24-29

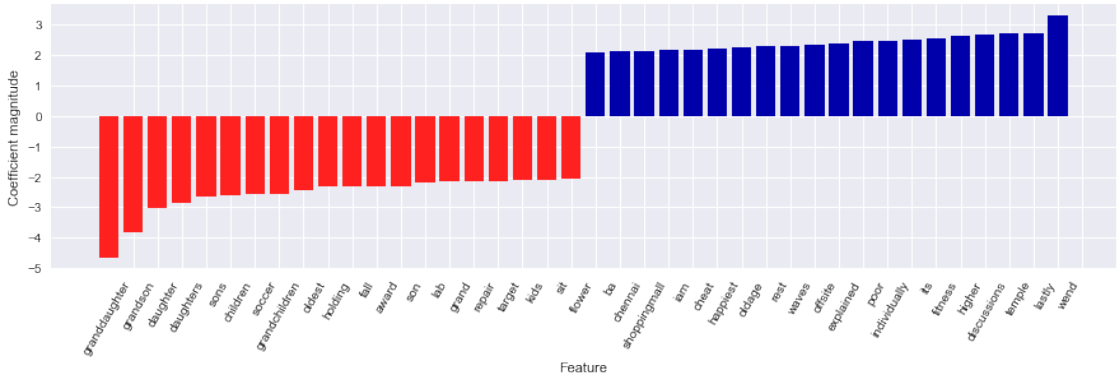
```
In [345]: hm_age_c.columns
```

```
Out[345]: Index(['hmid', 'wid', 'reflection_period', 'original_hm', 'cleaned_hm',
                 'modified', 'num_sentence', 'ground_truth_category',
                 'predicted_category', 'age', 'country', 'gender', 'marital',
                 'parenthood', 'age17-23', 'age24-29', 'age30-39', 'age40-49',
                 'age50-59', 'age_60plus'],
                dtype='object')
```

```
In [349]: target_y2=hm_age_c['age24-29']
          txtpred=hm_age_c.original_hm
          X2_train,X2_test, y2_train, y2_test=train_test_split(txtpred,target_y2)
```

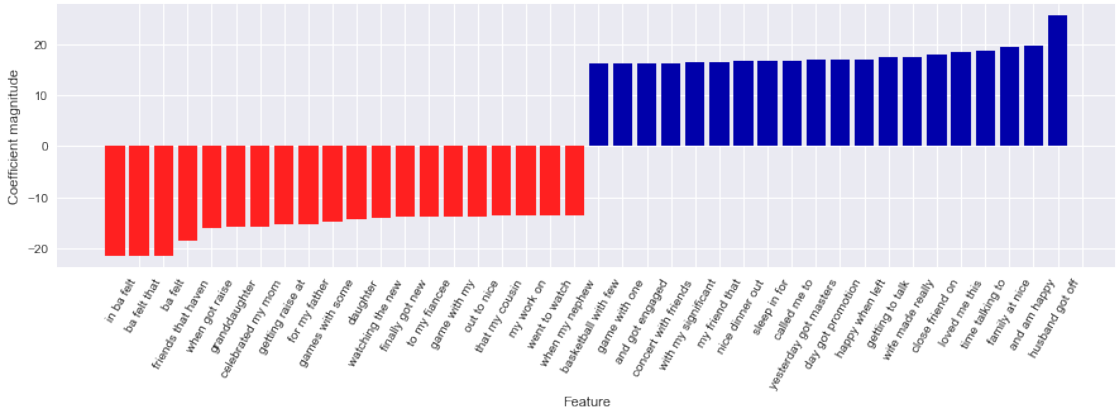
In [352]:
```
vect_norm_pipe=make_pipeline(CountVectorizer(),Normalizer(),
                                    LogisticRegression(class_weight='balanced'), memory="ca
param_grid = {"logisticregression__C": np.logspace(-0.5,1,8)}
grid = GridSearchCV(vect_norm_pipe,param_grid, cv=8, scoring="roc_auc" )
grid.fit(X2_train, y2_train)
feature_names = grid.best_estimator_.named_steps['countvectorizer'].get_feature_name
print('testing score for normalized countvectorizer:',grid.score(X2_test,y2_test))
print('best para:',grid.best_params_)
mglearn.tools.visualize_coefficients(grid.best_estimator_.named_steps['logisticregre
```

```
testing score for normalized countvectorizer: 0.6175463549519844
best para: {'logisticregression__C': 1.3894954943731375}
```



In [385]:
```
param_grid = {#"tfidfvectorizer__min_df": [0.02,0.025,0.03],
                "tfidfvectorizer__stop_words":[None, 'english']}
grid_tfid_young2 = GridSearchCV(make_pipeline(TfidfVectorizer(ngram_range=(1,3)),
                                LogisticRegressionCV(class_weight='balanced',solver='sag
                                memory="cache_folder"),param_grid=param_grid,cv=5,scorin
grid_tfid_young2.fit(X2_train, y2_train)
print('ROC AUC fo2r title lr with tuning (training set):',grid_tfid_young2.score(X2_
print('ROC AUC for title lr with tuning (testing set):',grid_tfid_young2.score(X2_te
print('best C for title lr model:',grid_tfid_young2.best_params_)
feature_names=grid_tfid_young2.best_estimator_.named_steps['tfidfvectorizer'].get_fe
mglearn.tools.visualize_coefficients(grid_tfid_young2.best_estimator_.named_steps['l
```

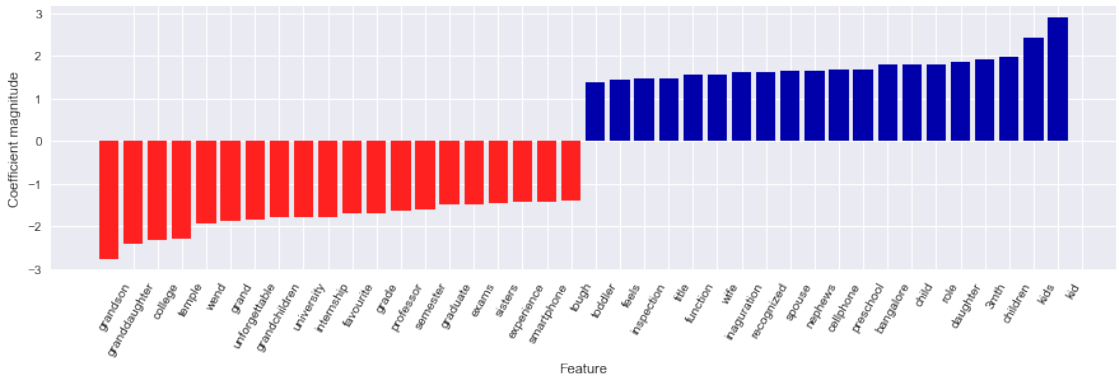
```
ROC AUC fo2r title lr with tuning (training set): 0.9995116202763875
ROC AUC for title lr with tuning (testing set): 0.6268739000015624
best C for title lr model: {'tfidfvectorizer__stop_words': None}
```



middle age group 30 - 39

```
In [378]: target_md1=hm_age_c['age30-39']
          txtpred=hm_age_c.original_hm
          X3_train,X3_test, y3_train, y3_test=train_test_split(txtpred,target_md1)

In [379]: vect_norm_pipe=make_pipeline(CountVectorizer(),Normalizer(),
                                       LogisticRegression(class_weight='balanced'), memory="ca
          param_grid = {"logisticregression__C": np.logspace(-1,1,8)}
          grid = GridSearchCV(vect_norm_pipe,param_grid, cv=8, scoring="roc_auc" )
          grid.fit(X3_train, y3_train)
          feature_names = grid.best_estimator_.named_steps['countvectorizer'].get_feature_name
          print('training score for normalized countvectorizer:',grid.score(X3_train,y3_train)
          print('testing score for normalized countvectorizer:',grid.score(X3_test,y3_test))
          print('best para:',grid.best_params_)
          mglearn.tools.visualize_coefficients(grid.best_estimator_.named_steps['logisticregre
```

```
training score for normalized countvectorizer: 0.6825853275982081
testing score for normalized countvectorizer: 0.6015168095933991
best para: {'logisticregression__C': 0.7196856730011519}
```

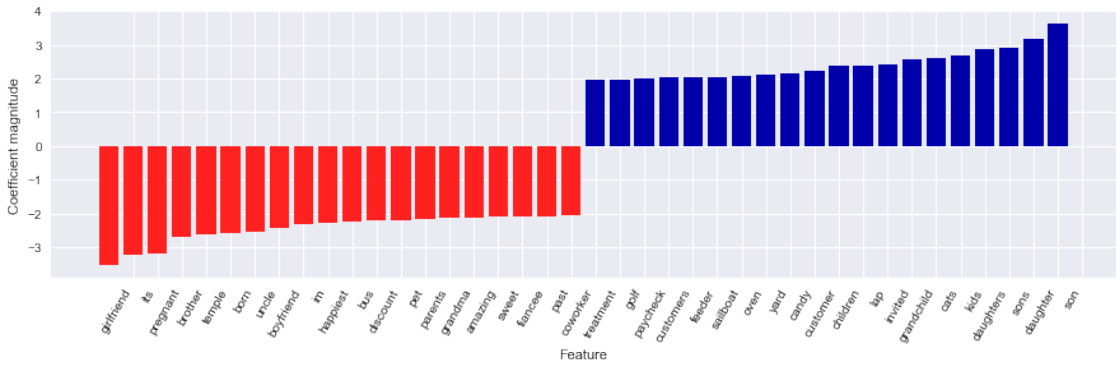


middle age group2 40 - 49

```
In [380]: target_md2=hm_age_c['age40-49']
          txtpred=hm_age_c.original_hm
          X4_train,X4_test, y4_train, y4_test=train_test_split(txtpred,target_md2)
```

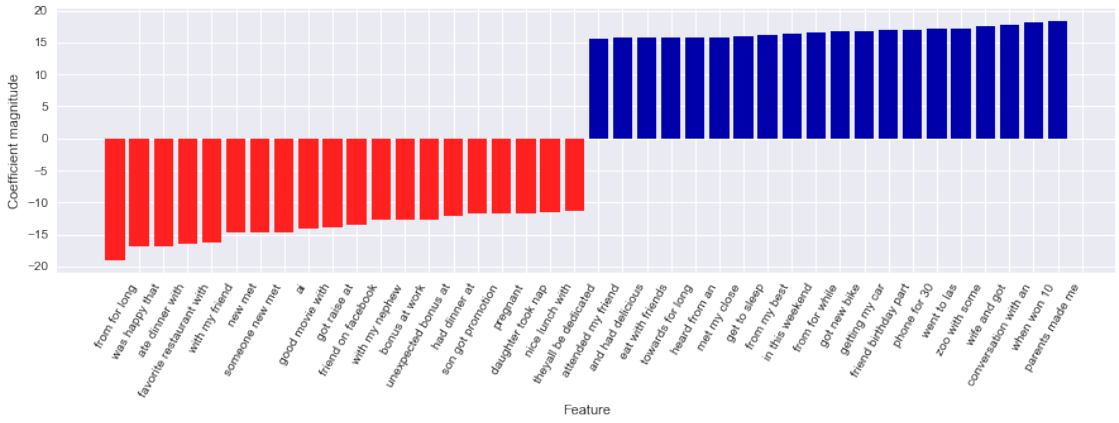
```
In [381]: vect_norm_pipe=make_pipeline(CountVectorizer(),Normalizer(),
                                       LogisticRegression(class_weight='balanced'), memory="ca
          param_grid = {"logisticregression__C": np.logspace(-1,0.5,8)}
          grid = GridSearchCV(vect_norm_pipe,param_grid, cv=8, scoring="roc_auc" )
          grid.fit(X4_train, y4_train)
          feature_names = grid.best_estimator_.named_steps['countvectorizer'].get_feature_names
          print('training score for normalized countvectorizer:',grid.score(X4_train,y4_train)
          print('testing score for normalized countvectorizer:',grid.score(X4_test,y4_test))
          print('best para:',grid.best_params_)
          mglearn.tools.visualize_coefficients(grid.best_estimator_.named_steps['logisticregres
```

```
training score for normalized countvectorizer: 0.7659076563365741
testing score for normalized countvectorizer: 0.6541329057188433
best para: {'logisticregression__C': 0.7196856730011519}
```




```
In [386]: param_grid = {#"tfidfvectorizer__min_df": [0.01,0.05,0.1],
                        "tfidfvectorizer__stop_words":[None, 'english']}
          grid_tfid_md = GridSearchCV(make_pipeline(TfidfVectorizer(ngram_range=(1,3)),
                                      LogisticRegressionCV(class_weight='balanced',solver='sag
                                      memory="cache_folder"),param_grid=param_grid,cv=5,scorin
          grid_tfid_md.fit(X4_train, y4_train)
          print('ROC AUC fo2r title lr with tuning (training set):',grid_tfid_md.score(X4_trai
          print('ROC AUC for title lr with tuning (testing set):',grid_tfid_md.score(X4_test,y
          print('best C for title lr model:',grid_tfid_md.best_params_)
          feature_names=grid_tfid_md.best_estimator_.named_steps['tfidfvectorizer'].get_featur
          mglearn.tools.visualize_coefficients(grid_tfid_md.best_estimator_.named_steps['logis
```

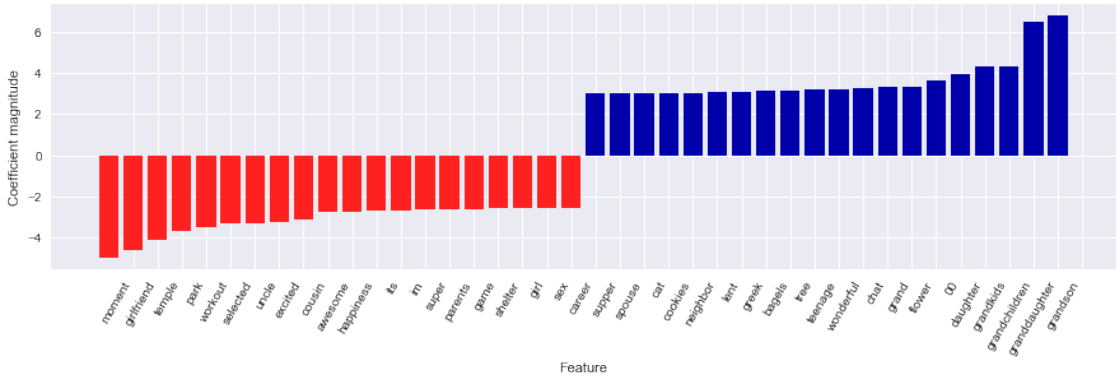
```
ROC AUC fo2r title lr with tuning (training set): 0.9999290666946256
ROC AUC for title lr with tuning (testing set): 0.6405758380314193
best C for title lr model: {'tfidfvectorizer__stop_words': None}
```



middle age group3 50 - 59

```
In [382]: target_md3=hm_age_c['age50-59']
          txtpred=hm_age_c.original_hm
          X5_train,X5_test, y5_train, y5_test=train_test_split(txtpred,target_md3)

In [383]: vect_norm_pipe=make_pipeline(CountVectorizer(),Normalizer(),
                                       LogisticRegression(class_weight='balanced'), memory="ca
          param_grid = {"logisticregression__C": np.logspace(-0.5,1,5)}
          grid = GridSearchCV(vect_norm_pipe,param_grid, cv=8, scoring="roc_auc" )
          grid.fit(X5_train, y5_train)
          feature_names = grid.best_estimator_.named_steps['countvectorizer'].get_feature_names
          print('training score for normalized countvectorizer:',grid.score(X5_train,y5_train))
          print('testing score for normalized countvectorizer:',grid.score(X5_test,y5_test))
          print('best para:',grid.best_params_)
          mglearn.tools.visualize_coefficients(grid.best_estimator_.named_steps['logisticregres
```

```
training score for normalized countvectorizer: 0.8527008621394687
testing score for normalized countvectorizer: 0.6831120025240247
best para: {'logisticregression__C': 0.7498942093324559}
```

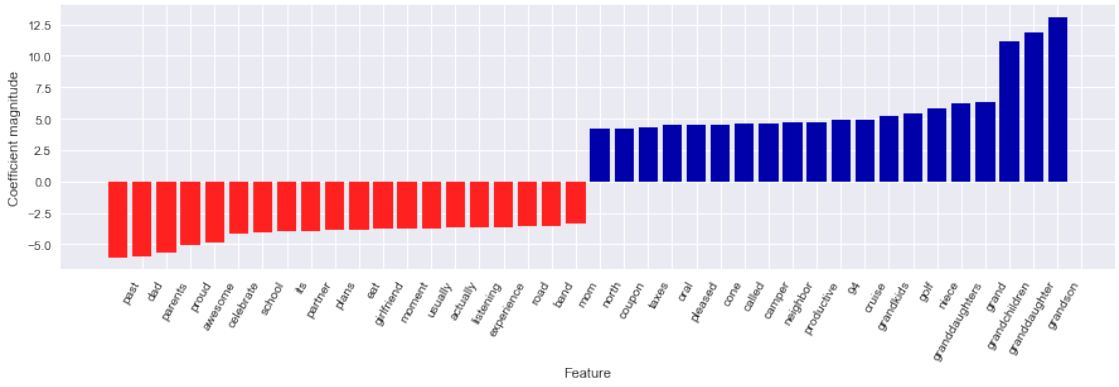



```
In [ ]: # param_grid = {"tfidfvectorizer__min_df": [3,4,5]}
        # grid_tfid_md = GridSearchCV(make_pipeline(TfidfVectorizer(ngram_range=(1,3)),
        #                             LogisticRegressionCV(class_weight='balanced',solver='sag
        #                             memory="cache_folder"),param_grid=param_grid,cv=5,scorin
        # grid_tfid_md.fit(X3_train, y3_train)
        # print('ROC AUC fo2r title lr with tuning (training set):',grid_tfid_md.score(X3_trai
        # print('ROC AUC for title lr with tuning (testing set):',grid_tfid_md.score(X3_test,y
        # print('best C for title lr model:',grid_tfid_md.best_params_)
        # feature_names=grid_tfid_md.best_estimator_.named_steps['tfidfvectorizer'].get_featur
        # mglearn.tools.visualize_coefficients(grid_tfid_md.best_estimator_.named_steps['logis
```

the elder group 60 +

```
In [360]: target_o=hm_age_c['age_60plus']
          txtpred=hm_age_c.original_hm
          X5_train,X5_test, y5_train, y5_test=train_test_split(txtpred,target_o)

In [361]: vect_norm_pipe=make_pipeline(CountVectorizer(),Normalizer(),
                                       LogisticRegression(class_weight='balanced'), memory="ca
          param_grid = {"logisticregression__C": np.logspace(-2,2,5)}
          grid = GridSearchCV(vect_norm_pipe,param_grid, cv=8, scoring="roc_auc" )
          grid.fit(X5_train, y5_train)
          feature_names = grid.best_estimator_.named_steps['countvectorizer'].get_feature_names
          print('training score for normalized countvectorizer:',grid.score(X5_train,y5_train))
          print('testing score for normalized countvectorizer:',grid.score(X5_test,y5_test))
          print('best para:',grid.best_params_)
          mglearn.tools.visualize_coefficients(grid.best_estimator_.named_steps['logisticregres
```

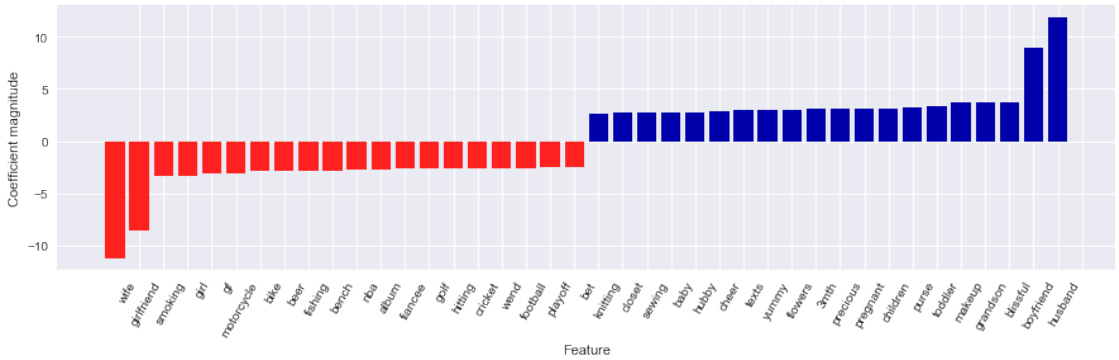
```
training score for normalized countvectorizer: 0.9268689618637426
testing score for normalized countvectorizer: 0.7505892408209904
best para: {'logisticregression__C': 1.0}
```



0.0.4 Gender prediction , female vs male

```
In [401]: target_gender=pd.get_dummies(hm_age_c['gender'])[['f']]
          txtpred=hm_age_c.original_hm
          X6_train,X6_test, y6_train, y6_test=train_test_split(txtpred,target_gender)

In [402]: vect_norm_pipe=make_pipeline(CountVectorizer(),Normalizer(),
                                       LogisticRegression(class_weight='balanced'), memory="ca
          param_grid = {"logisticregression__C": np.logspace(-0.5,1,5)}
          grid = GridSearchCV(vect_norm_pipe,param_grid, cv=8, scoring="roc_auc" )
          grid.fit(X6_train, y6_train)
          feature_names = grid.best_estimator_.named_steps['countvectorizer'].get_feature_name
          print('training score for normalized countvectorizer:',grid.score(X6_train,y6_train)
          print('testing score for normalized countvectorizer:',grid.score(X6_test,y6_test))
          print('best para:',grid.best_params_)
          mglearn.tools.visualize_coefficients(grid.best_estimator_.named_steps['logisticregre
```

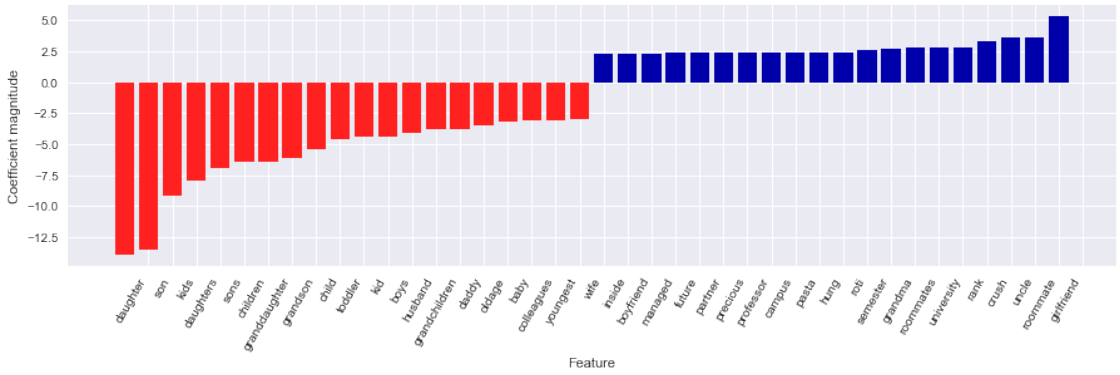
```
training score for normalized countvectorizer: 0.7832709300815508
testing score for normalized countvectorizer: 0.7206674104445694
best para: {'logisticregression__C': 1.7782794100389228}
```



0.0.5 Parenthood prediction - yes vs no

```
In [566]: # predicting no
          target_parenthood=pd.get_dummies(hm_age_c['parenthood'])[['n']]
          txtpred=hm_age_c.original_hm
          X8_train,X8_test, y8_train, y8_test=train_test_split(txtpred,target_parenthood)

In [411]: vect_norm_pipe=make_pipeline(CountVectorizer(),Normalizer(),
                                       LogisticRegression(class_weight='balanced'), memory="ca
          param_grid = {"logisticregression__C": np.logspace(0,1,6)}
          grid_parent = GridSearchCV(vect_norm_pipe,param_grid, cv=8, scoring="roc_auc" )
          grid_parent.fit(X8_train, y8_train)
          feature_names = grid_parent.best_estimator_.named_steps['countvectorizer'].get_featu
          print('training score for normalized countvectorizer:',grid_parent.score(X8_train,y8
          print('testing score for normalized countvectorizer:',grid_parent.score(X8_test,y8_t
          print('best para:',grid_parent.best_params_)
          mglearn.tools.visualize_coefficients(grid_parent.best_estimator_.named_steps['logist
```

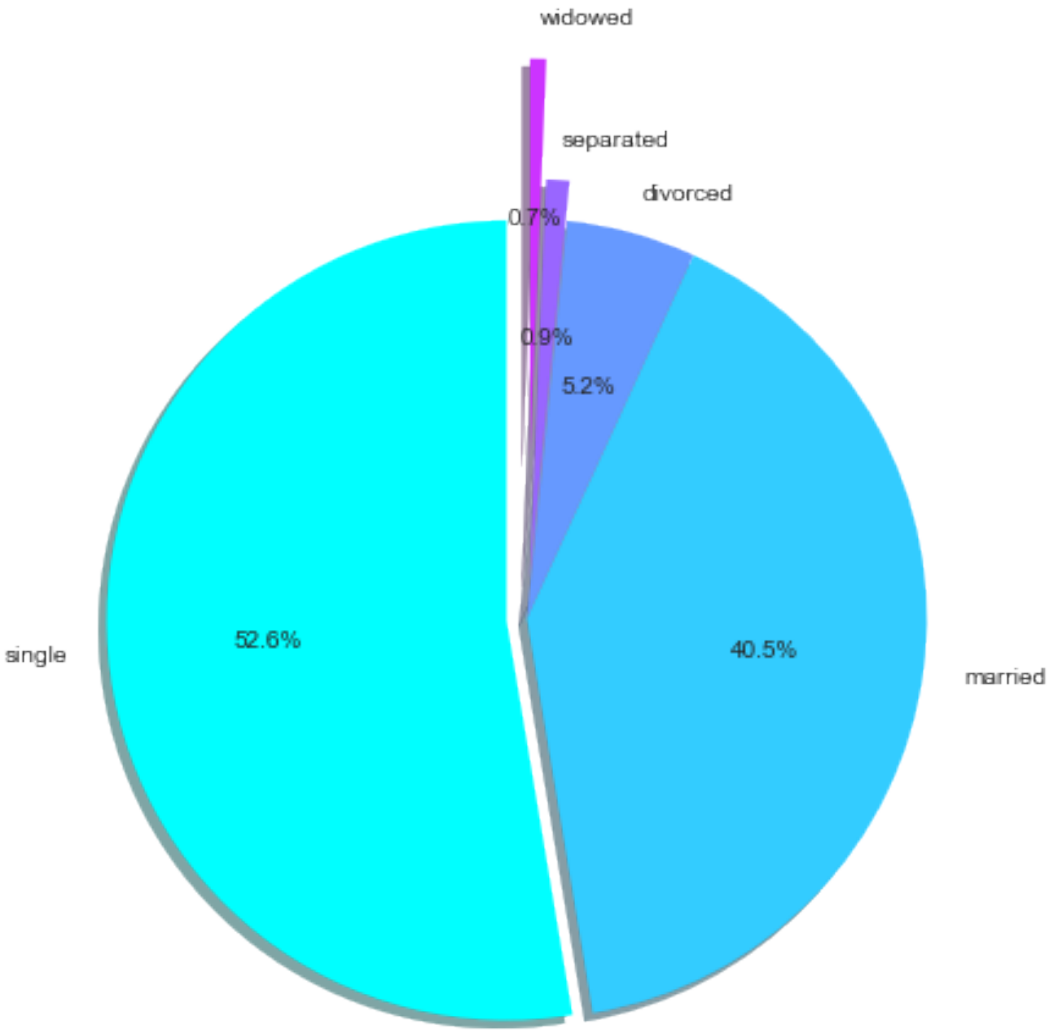
```
training score for normalized countvectorizer: 0.7998071302784648
testing score for normalized countvectorizer: 0.7422138570107606
best para: {'logisticregression__C': 1.7782794100389228}
```



0.0.6 Predicting marital status - only included the two main group married & single

```
In [436]: demo.marital.value_counts()/demo.shape[0]

Out[436]: single       0.523608
          married      0.403080
          divorced     0.052103
          separated    0.009406
          widowed      0.006547
          Name: marital, dtype: float64
```

In [574]:
```
labels = demo.marital.value_counts().index
sizes = demo.marital.value_counts().values
explode = (0.05, 0, 0, 0.1,0.4)

fig1, ax1 = plt.subplots(figsize=(8,8))
theme = plt.get_cmap('cool')
ax1.set_prop_cycle("color", [theme(1. * i / len(sizes)) for i in range(len(sizes))])
ax1.pie(sizes,   explode=explode,labels=labels, autopct='%1.1f%%',
        shadow=True, startangle=90)
ax1.axis('equal')  # Equal aspect ratio ensures that pie is drawn as a circle.
ax1.set_yticklabels({'fontsize=15'})
plt.show()
```

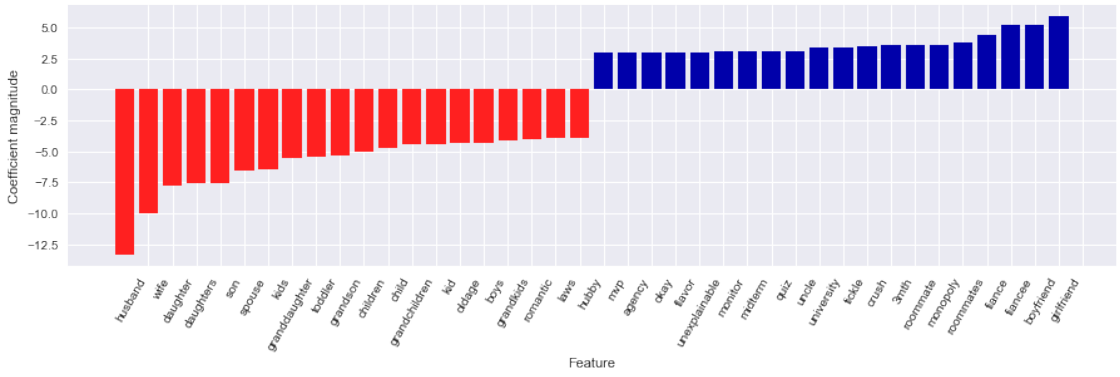


In [414]:
```
target_marital_s=pd.get_dummies(hm_age_c['marital'])[['single']]
```

```
txtpred=hm_age_c.original_hm
X9_train,X9_test, y9_train, y9_test=train_test_split(txtpred,target_marital_s)
```

In [416]:
```
vect_norm_pipe=make_pipeline(CountVectorizer(),Normalizer(),
                             LogisticRegression(class_weight='balanced'), memory="ca
param_grid = {"logisticregression__C": np.logspace(-1,1,5)}
grid_marital = GridSearchCV(vect_norm_pipe,param_grid, cv=8, scoring="roc_auc" )
grid_marital.fit(X9_train, y9_train)
feature_names = grid_marital.best_estimator_.named_steps['countvectorizer'].get_featu
print('training score for normalized countvectorizer:',grid_marital.score(X9_train,y9
print('testing score for normalized countvectorizer:',grid_marital.score(X9_test,y9_t
print('best para:',grid_marital.best_params_)
mglearn.tools.visualize_coefficients(grid_marital.best_estimator_.named_steps['logist
```

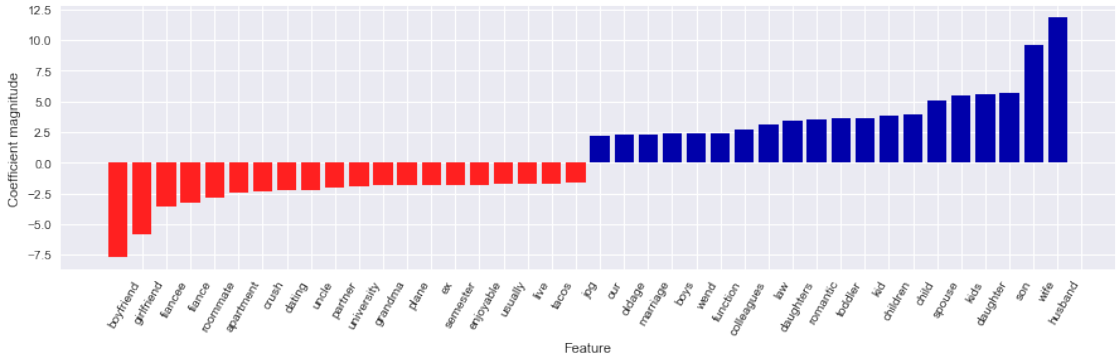
```
training score for normalized countvectorizer: 0.8045365388268331
testing score for normalized countvectorizer: 0.7312309422610357
best para: {'logisticregression__C': 3.1622776601683795}
```



In [417]:
```
target_marital_m=pd.get_dummies(hm_age_c['marital'])[['married']]
txtpred=hm_age_c.original_hm
X10_train,X10_test, y10_train, y10_test=train_test_split(txtpred,target_marital_m)
```

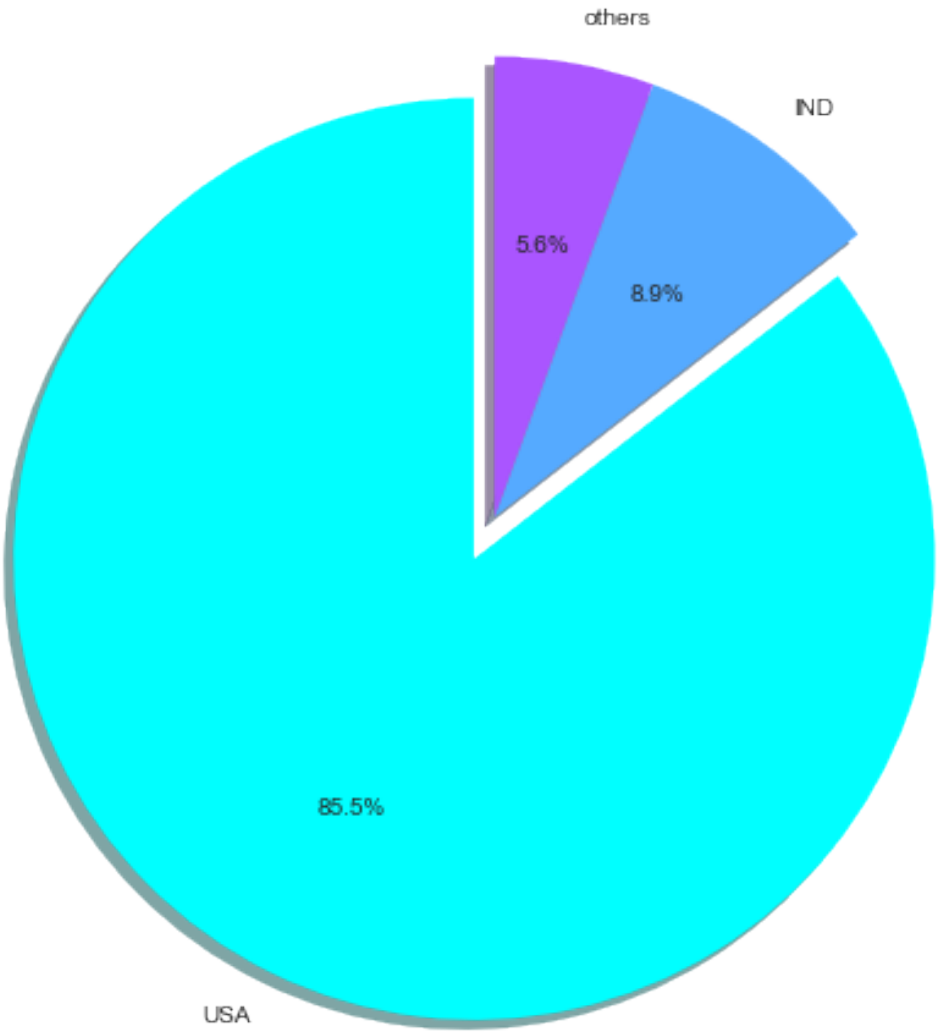
In [418]:
```
vect_norm_pipe=make_pipeline(CountVectorizer(),Normalizer(),
                             LogisticRegression(class_weight='balanced'), memory="ca
param_grid = {"logisticregression__C": np.logspace(-1,1,5)}
grid_marital_m = GridSearchCV(vect_norm_pipe,param_grid, cv=8, scoring="roc_auc" )
grid_marital_m.fit(X10_train, y10_train)
feature_names = grid_marital_m.best_estimator_.named_steps['countvectorizer'].get_fea
print('training score for normalized countvectorizer:',grid_marital_m.score(X10_trai
print('testing score for normalized countvectorizer:',grid_marital_m.score(X10_test,
print('best para:',grid_marital_m.best_params_)
mglearn.tools.visualize_coefficients(grid_marital_m.best_estimator_.named_steps['log
```

```
training score for normalized countvectorizer: 0.7816552857822818
testing score for normalized countvectorizer: 0.7346918905552816
best para: {'logisticregression__C': 1.0}
```



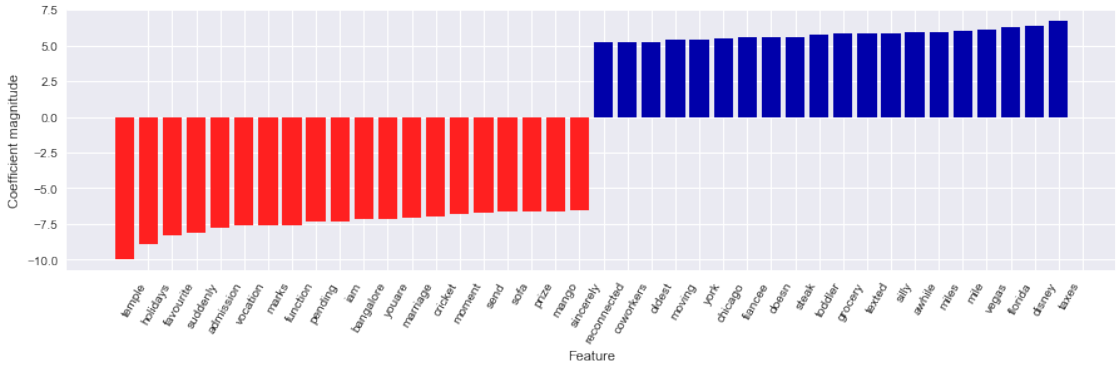
predicting country - only USA

```
In [575]: labels = ['USA','IND','others']
          sizes = [percent_country.USA,percent_country.IND,(1-percent_country.iloc[:2].sum())]
          explode = (0.1, 0, 0)

          fig1, ax1 = plt.subplots(figsize=(8,8))
          theme = plt.get_cmap('cool')
          ax1.set_prop_cycle("color", [theme(1. * i / len(sizes)) for i in range(len(sizes))])
          ax1.pie(sizes,explode=explode,labels=labels, autopct='%1.1f%%',
                  shadow=True, startangle=90) #
          ax1.axis('equal')
          plt.show()
```




```
In [576]: target_USA=pd.get_dummies(hm_age_c['country'])[['USA']]
          txtpred=hm_age_c.original_hm
          X11_train,X11_test, y11_train, y11_test=train_test_split(txtpred,target_USA)

In [577]: vect_norm_pipe=make_pipeline(CountVectorizer(min_df=20),Normalizer(),
                                       LogisticRegression(class_weight='balanced'), memory="ca
          param_grid = {"logisticregression__C": np.logspace(0.5,1.5,5)}
          grid_USA = GridSearchCV(vect_norm_pipe,param_grid, cv=8, scoring="roc_auc" )
          grid_USA.fit(X11_train, y11_train)
          feature_names = grid_USA.best_estimator_.named_steps['countvectorizer'].get_feature_
          print('training score for normalized countvectorizer:',grid_USA.score(X11_train,y11_
          print('testing score for normalized countvectorizer:',grid_USA.score(X11_test,y11_te
          print('best para:',grid_USA.best_params_)
          mglearn.tools.visualize_coefficients(grid_USA.best_estimator_.named_steps['logisticr
```

```
training score for normalized countvectorizer: 0.9041186140588519
testing score for normalized countvectorizer: 0.8712846066046449
best para: {'logisticregression__C': 5.623413251903491}
```

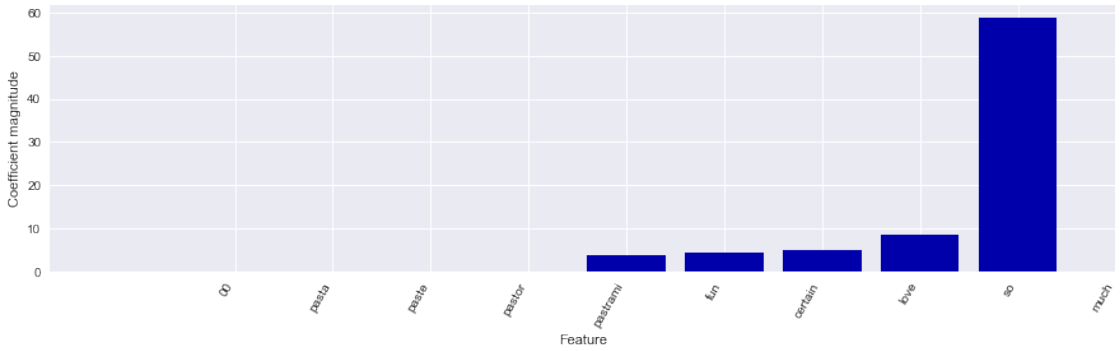



```
In [486]: grid_USA.best_estimator_.named_steps['logisticregression'].coef_.shape

Out[486]: (1, 23315)
```

0.0.7 Topic model

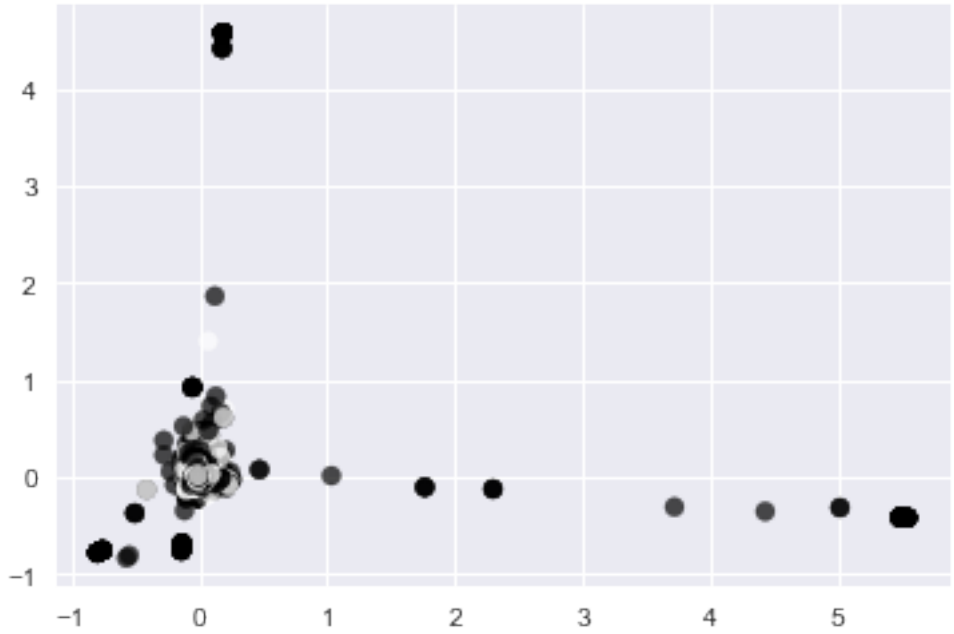
```
In [508]: target_y2=pd.get_dummies(hm_age_c['gender'])['m']
          txtpred=hm_age_c.original_hm
          X2_train,X2_test, y2_train, y2_test=train_test_split(txtpred,target_y2)

In [509]: from sklearn.feature_extraction.text import CountVectorizer
          vect = CountVectorizer(min_df=2)
          X_train = vect.fit_transform(X2_train)
          X_train.shape

Out[509]: (74655, 13473)

In [518]: from sklearn.decomposition import TruncatedSVD
          from sklearn.preprocessing import MaxAbsScaler
          from sklearn.decomposition import NMF
          scaler = MaxAbsScaler()
          X_scaled = scaler.fit_transform(X_train)
          lsa_scaled = NMF(n_components=100)
          X_lsa_scaled = lsa_scaled.fit_transform(X_scaled)

In [520]: # plt.semilogy(lsa_scaled.explained_variance_ratio_)

In [521]: lsa_scaled.components_.shape

Out[521]: (100, 13473)
```

In [522]:
```
feature_names=vect.get_feature_names()
mglearn.tools.visualize_coefficients(lsa_scaled.components_[0,:], feature_names, n_t
```



In [516]:
```
plt.scatter(X_lsa_scaled[:, 2], X_lsa_scaled[:, 3], alpha=.7, c=y2_train)
```

Out[516]:
```
<matplotlib.collections.PathCollection at 0x1b50566a0>
```



0.0.8 Trying to predict the category of the happy moment

In [12]:
```
target=hm.ground_truth_category
target_predicted=hm.predicted_category
target_predicted_num=preprocessing.label_binarize(target_predicted, classes=[0, 1, 2,
```

```
In [14]: predictors=hm.drop(columns=['ground_truth_category','predicted_category','hmid', 'wid

In [15]: demopredictor=hm.iloc[:,-5:]
         demopredictor_dumm=pd.get_dummies(demopredictor)

In [16]: X_train,X_test, y_train, y_test=train_test_split(demopredictor_dumm,target_predicted)

In [20]: X_train_w,X_test_w, y_train_w, y_test_w=train_test_split(predictors.cleaned_hm,target_

In [21]: vect = CountVectorizer()
         X_train_w = vect.fit_transform(X_train_w)
         X_test_w= vect.transform(X_test)
         feature_names = vect.get_feature_names()

In [26]: #train on title logistic regression w/o tuning
         from sklearn.svm import LinearSVC
         tree_simple =tree.DecisionTreeClassifier(max_depth=2).fit(X_train_w, y_train)
         # mglearn.tools.visualize_coefficients(lr.coef_, feature_names, n_top_features=20)
         # plt.show()

In [33]: from sklearn.svm import LinearSVC
         # lr =LogisticRegression(class_weight='balanced',multi_class='ovr').fit(X_train_w, y_
         lr_train=lr.score(X_train_w, y_train_w)
         lr_test=lr.score(X_train_w, y_train_w)
         print("score (training set):",lr_train)
         print("score(testing set):",lr_test)
         print("C for untuned lr: 1")
         # mglearn.tools.visualize_coefficients(lr.coef_, feature_names, n_top_features=20)
         # plt.show()

score (training set): 0.9749207570191377
score(testing set): 0.9749207570191377
C for untuned lr: 1


In [ ]:
```